DOCUMENT RESUME

ED 334 990 IR 015 153

AUTHOR Knupfer, Nancy Nelson; And Others
TITLE Educational Computing Social Foundations: A Symposium.
PUB DATE 91
NOTE 53p.; In: Proceedings of Selected Research Presentations at the Annual Convention of the Association for Educational Communications and Technology; see IR 015 132.
PUB TYPE Viewpoints (Opinion/Position Papers, Essays, etc.) (120) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC03 Plus Postage.
DESCRIPTORS *Computer Uses in Education; Curriculum Development; Distance Education; *Educational Change; Educational History; *Educational Technology; Elementary Secondary Education; Equal Education; Political Influences; Postsecondary Education; Science and Society; Socioeconomic Influences; *Teacher Education; Teacher Role; Teaching Methods

ABSTRACT

An abstract introduces this collection of three papers and two abstracts of papers from a symposium at which experts presented their viewpoints about the social, political, and economic issues surrounding the use of computers in schools. Each of the following five investigations provides an important perspective on such issues: (1) "Educational Computing and Teachers: Changing Roles, Changing Pedagogy" (Nancy Nelson Knupfer); "Teachers, Computers, and Power" (Robert Muffoletto--abstract only); (3) "Economic, Political, and Social Issues That Affect the Growth of Distance Education" (Marina Stock McIsaac); (4) "The History' of Technology and Education" (Alfred Bork); and (5) "Educational Technology Curriculum Theory: Toward a New Language of Possibility" (J. Randall Koetting--abstract only). Two of the three papers provide references. (BBM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☐ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED334990

Title:

Educational Computing Social Foundations: A Symposium

Authors:

Nancy Nelson Knupfer
Robert Muffoletto
Marina Stock McIsaac
Alfred Bork
Randall Koetting
Andrew R. J. Yeaman

120/153

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Michael R. Simonson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

EDUCATIONAL COMPUTING SOCIAL FOUNDATIONS

Abstract

The purpose of this symposium is to present a collection of six related papers and viewpoints about the social, political, and economic issues surrounding the use of computers in schools. This session will make the audience aware of some of the major social issues surrounding the use of computers in education, cause them to reflect upon the effects of particular research findings and applications currently being implemented in education, and provide direction for those in positions to implement educational innovations.

Each of the six investigations will provide an important perspective on educational issues related to the use of computer technology in schools, its conceptualization, practices, effects, or implications. We hope to provide a collection of ideas that have been traditionally ignored in teacher education and graduate studies, but beg to be addressed. It is from this perspective that we wish to form the contents and context of this symposium.

Each presenter will address a particular aspect of a critical social issue related to the presence of computers in the schools. These issues include historical perspectives on technology and education, teacher education, reskilling of teachers, distance education, equity, change and reform in both pedagogy and institutional structure, concepts of the individual, power and control, machine as expert, issues surrounding courseware evaluation, the effects of computers on teachers, students, curriculum and knowledge, and the question of aesthetics and creativity in educational computing. Papers will be available for the audience.

The papers will be a collection of essays written by experts from universities throughout the United States in both education and educational technology. The symposium will appeal to teacher educators, administrators, teachers, community members involved in education, and students in teacher education, educational computing, or educational technology.

Title:

Educational Computing and Teachers: Changing Roles, Changing Pedagogy

Author:

Nancy Nelson Knupfer

EDUCATIONAL COMPUTING AND TEACHERS:

CHANGING ROLES, CHANGING PEDAGOGY

Dr. Nancy Nelson Knupfer
Arizona State University

Stimulated by rapid technological advancements, the widespread diffusion of microcomputers across all levels of our economy and society has created a demand for substantive computer education. Although parents, government, and school officials recognize that students must prepare for citizenship in a computer-based society, the mere acquisition of computers for the schools is but one small facet of the much larger and more complex task of implementing this potentially significant innovation in education. The careful planning and proper implementation of informed computer education programs, free from unreasonable expectations, will determine the value of this innovation (Goodlad, 1975; Romberg & Price, 1981). Further, the success of any such implementation effort will depend largely upon the teachers who determine the daily school activities (Cuban, 1986). Indeed, the personal and professional relationships among teachers, students, and administrators can have a greater influence on the future of any proposed innovation than the most generous outlays of money and machines.

An accurate view of educational change and implementation of innovations considers the environment within the schools (Berman, 1981; Berman & McLaughlin, 1978; Sarason, 1982). For example, the introduction of computers might change the grouping of students or the amount and quality of interactions between students and teachers, or the very pedagogy of lesson structure. Further, changes in teachers' roles are emerging, which in turn create changes in their relationships with other teachers and with administrators. The current implementation of educational computing is a "social interaction" approach which draws its strength from the practical ideas promoted by teachers and from the directed support of the administration, parents and local community (Knupfer, 1987).

The structure of official authority over computer education varies and can affect implementation. Teachers assume different roles in the change process; some are resisters, while others are active change agents (Knupfer, 1987). This variation of attitudes toward technology can create bridges or gulfs between faculty members, and certainly leads to a hierarchy of power concerning decisions about computer implementation within school buildings, within school districts, and sometimes throughout an entire state.

Implementing computer technology in schools has brought about some obvious changes along with changes which are more subtle, yet

carry a full impact. These changes affect teaching pedagogy, the relationship between teachers, the emphasis of inservice training, specific teaching duties, and changes in institutional structure.

Determining Access

Determining access to computers is based upon a number of factors. Some of those factors include the number and location of computers, and the type of software available. Factors which are less obvious are the skill and comfort level of the teacher along at least four dimensions: familiarity of with hardware; familiarity with software; comfort with the different needs of instructional computing as it affect lessons and classroom structure; and, time to prepare.

The number and placement of machines influences access and could possibly scuttle the implementation effort. An insufficient supply of machines predisposes the school in favor of group use at the expense of individualized instruction, contrary to the objectives of the curriculum. In studying the elementary schools, Becker (1985) found that although locating computers in laboratories promoted students' enthusiasm for school, it also fostered the dominance of usage by "above-average" students. On the other hand, placement of computers in the classrooms led to usage by fewer teachers and for a narrower range of applications than the laboratory location. Becker's study also found that placement of computers within libraries promoted more equal usage of computers between "above-" and "below-average" students, but that teachers reported less positive social outcomes and low enthusiasm among students. Placement of computers in each classroom, in a computer lab, or in a central location such as the library without planning and preparation can lead to undesirable results.

In addition to these material factors, existing myths and prejudices about computer use can produce decisions by the school, the teachers, or the district that directly affect equity (equal opportunity for all students) by setting questionable criteria for access. Often, a few highly interested students and teachers monopolize access to the machines by exploiting popular misconceptions about the complexity of computers, thereby constructing psychological or social barriers to entry into their privileged domain. Also, the school's laudable dedication to the special needs of remedial or gifted and talented students can end up restricting access by establishing budget and curriculum priorities that reserve computers for these special groups.

Existing prejudices cover more than just computers, too; for example, ingrained deficiencies in the school's curriculum or the presence of social discrimination, both originating long before the machines arrived, can combine with and even intensify prevailing opinions about computers. Curriculum guidelines that determine

competence by grade level alone artificially group students and create unreasonable variations in accessibility.

Certainly, the speed of technological change has intensified problems of equity. The computer's sudden appearance in the classroom, enhanced by its reputation as a highly-touted symbol of the new age in communications, is often misinterpreted as the sign of real, substantive change in education. This false impression encourages both distorted notions about the computer's usefulness and unrealistic expectations about the students' and teachers' ability to learn from the innovation. Schools can get swept up in the computer revolution and lose sight of the machines' potential and limitations, finally losing control of the implementation.

Considering the Curriculum

When developing their computer curricula, schools filter information through criteria shaped very much by familiar institutional patterns and imperatives. For example, curriculum decisions that exclude the entire teaching staff with the significant exceptions of a few well informed teacher experts may suit the current temperament of some staff members, but this approach can stifle discussion about the merits and liabilities of computer education and thereby fragment the implementation, an obvious contradiction between intended integration and the actual practice (Donovan, 1984).

Currently popular opinions about general issues in education have also intertwined with issues in computer education. The public's demand for more teacher training reflects an understandable concern over the efficacy of the schools, but it also leads to hasty decisions and poor planning. As schools rush to respond by requiring more intensive training of teachers in computer operations and by acquiring more software, the original objective of the implementation fades into the background. Nearly a decade ago Sheingold, Kane, Endreweit, and Billings (1981) warned that a sober assessment of the students' needs must temper the school's reaction to public outcry to prevent the sacrifice of the implementation's outcome to only one dimension of the entire process of implementation.

Many programs currently used in educational computing do not fully utilize instructional strategies to best facilitate learning. If this technology is to be truly beneficial and remain a valuable part of our educational system, we must use what history tells us of good teaching techniques and sound innovational strategies, and then apply critical planning and evaluation throughout implementation. It is imperative that computers do not determine curriculum, but that schools formulate their curriculum first and then consider how computers can best serve the instructional objectives and activities of that curriculum.

Critical Nature of Teaching Roles and Pedagogy

The expanding literature on computer education reveals a diverse field of information cluttered with bits of educational theory, curriculum design and implementation plans. However, the best laid plans for implementation of computer curricula depend upon the interaction of the teachers, students, and administrators to make the plans successful. According to Sherif (1970), it is important to realize that the locus of change lies in the interaction between people and that the most effective changes in institutions and attitudes are products of interaction. Sherif's statement emphasizes the importance of realizing the pertinence of social interaction theory and addressing the study of implementation of educational computing from within that context.

Computers and computing are rapidly achieving a prominence in American society, economy, and culture that schools must recognize. Instructional computing challenges the traditional instructional focus, possibly transferring it from the individual teachers to a multitude of instructional sources (programs). This challenge places unusual stresses on the classroom teacher and amplifies the importance of the teacher's attitude toward computers. It is the teacher who lives with the innovation and it is ultimately the teacher who will accept or reject, implement successfully or fail to implement technology in the classroom.

Indisposition to rapid change is a feature of the educational system. Resistance rises from several sources, but these may be classified under the general headings of "reason" and "habit." As with any entrenched institution, the educational system is suspicious of changes that inject new patterns of behavior and threaten traditional beliefs. Computers represent change, but not in a form most educators totally understand. The introduction of computers requires modifications in behavior and instruction that may be unanticipated by the staff; preconceptions about the complexity of computers, the sudden realization that hours of training in a new skill could displace previously important activities, and the zeal of the machine's advocates all can induce fears that this new tool is incompatible with the vital working habits that lubricate personal and professional relationships. Resistance to the change naturally follows. The profession's natural conservatism is only one possible source of resistance, however; the staff's dedication to the institution's objectives, a loyalty based on reason as well as habit, automatically renders suspicious any proposed changes. Although advance preparation for change is no guarantee that resistance will disappear, it will disarm some potential sources of opposition and increase the likelihood of more reasoned argument about an innovation's possible costs and benefits.

The implementation of computer technology is a process of mutual adaptation as the schools blend their individual characteristics with the requirements of a new educational tool. For instance, the incorporation

of computers to assist with routine administrative paperwork can produce an interest in training students to operate the machines, which in turn leads to proposals for formal instruction in a number of applications. As students and teachers become familiar with the machines, new demands for new uses arise, and the school is forced to respond.

Previously, computer education was limited to understanding how to use a complicated machine, but technological developments have shifted the limit from the hardware to the human imagination. Imagination about how to use computers in education can lead to creative implementation ideas. Those teachers with creative ideas will continue to stimulate students' interest in the computer, but those teachers who fall behind will soon face the problem of declining student interest as the novelty of computing wears thin.

In general, there is a positive relationship between teachers' expectations and students' achievement. Teachers' attributes influence their thoughts and behaviors toward students. Therefore, teachers' opinions about computer usefulness will influence their motivation to use instructional computing with their students.

Although more computers are being placed in schools, the new equipment has not necessarily improved education. A study completed during the pre-microprocessor age, for instance, warned of the educational system's intrinsic resistance to change and concluded that the rigid, decentralized yet inflexible structure of education stifled any meaningful innovation in pedagogy and curriculum that might have arisen from access to computer (Oettinger, 1969, in Sheingold, et al., 1981, p. 3).

Perhaps the reason that we do not know enough about implementing computers into the schools is because rapid technological changes have outpaced teacher training and curriculum development (Becker, 1986). Changes often seem to take place for no apparent reason, but are based upon innovation for its own sake, with no clear direction. Past experience demonstrates that rushing to place equipment in schools without adequate planning can lead to failure of an innovation (Cuban, 1986; Fullan & Pomfret, 1977; Goodlad & Klein, 1970).

The successful assimilation of computer technology into education must occur along four related dimensions. The first level of assimilation, understanding the process of educational change, must precede the second level, planned implementation of an innovation. But any practical implementation also assumes the third dimension, an understanding of the broad possible applications of computers to education. Finally, the successful integration of computers to education requires its acceptance by a large, diverse, and at times fragmented constituency; therefore the pressures arising from limited availability and uneven distribution of this

educational innovation must be overcome in favor of equal access to and quality time at the computers.

Many influential proponents of instructional computing have stressed the issues involved with the process of change, implementation, and equity but have given short thrift to the role of the teachers. Yet, the teacher is essential to the successful implementation of computers, or any school change, into the daily classroom activities (Cuban, 1986). It is the teacher who must adopt computers and then adapt them to curriculum goals and classroom needs (Cuban, 1986; Fullan, 1982).

The teacher's role in schools and school change is so important (Cuban, 1986; Fullan, 1982; Sarason, 1982) that educational change depends on what they do and think (Sarason, 1982). Several factors must be considered in assessing the teacher's role in educational change. The teacher's role must be central to any change; because the teacher lives and works in a classroom with its own built-in imperatives and social culture, the teacher's real working conditions must be taken into account; finally, reformers must realize that the teacher will judge the acceptability of any change by its conformance to current needs and objectives, and not according to some agenda that is foreign to the teacher's experience. In short, teachers must help to guide educational change, and not be its victims.

Powerful implementation of computers into the curricula calls, at most, for a change in the structure of schools and, at least, for a change in the structure of daily lessons. Whether this will happen and how it will happen depends upon the classroom teachers. Even the most traditional teachers who use computers effectively in their classrooms are finding that once they become secure with their ability to implement the technology, the very structure of their teaching changes. Instead of being the source of information, the teacher becomes the facilitator of information, guiding the student in the direction of a solution and perhaps encountering larger issues along the way. In solving the steps of a problem, the students often become more knowledgeable about the topic than the teacher. In order to be successful at this method, the teacher must be willing to release the control of learning to the students, and feel secure in a different role. In such a role there is potential for the students and teacher to learn together, to learn by discovery, to access information beyond the intent of the original lesson plan, and to explore new types of projects.

The balance of incentives and disincentives from the perspective of informed teachers helps explain the results of any change or implementation effort. The teacher's viewpoint of need, clarity, and personal cost/benefit ratio will determine the implementation process. The criteria teachers use to evaluate the change must tip the balance in favor of the change at some point early in the implementation process.

The computer is not just a new piece of equipment added to the classroom, but it calls for changes in the organization of teaching, classroom management, and social interactions during the learning process. Supporting the teacher throughout the implementation process, from planning through evaluation, revision, and ongoing implementation, is critical to the success of instruction computing efforts.

References

Becker, H. J. (1986, June). *Instructional Uses of School Computers. Reports from the 1985 National Survey. Issue Number 1.* Center for Social Organization of Schools, The Johns Hopkins University.

Becker, H. J. (1985, March). *How Schools Use Microcomputers: Summary of the First National Survey.* Center for Social Organization of Schools, The Johns Hopkins University.

Berman, P. (1981). Toward an Implementation Paradigm. In R. Lehming and M. Kane (Eds.), *Improving Schools.* Beverly Hills, CA: Sage.

Berman, P. & McLaughlin, M. (1978). *Federal Programs Supporting Educational Change, Vol. VIII, Implementing and Sustaining Innovations.* Santa Monica, CA: Rand Corporation.

Cuban, L. (1986). *Teachers and Machines: The Classroom Use of Technology Since 1920.* New York: Teachers College Press.

Donovan, B. F. (1984). *Power and Curriculum Implementation: A Case Study of an Innovatory Mathematics Program.* Paper presented at meetings of the American Educational Research Association.

Fullan, M. (1982). *The Meaning of Educational Change.* New York: Teachers College Press.

Fullan, M. & Pomfret, A. (1977). *Research on Curriculum and Instruction Implementation.* Review of Educational Research, 47 (1), 335-397.

Goodlad, J. (1975). *The Dynamics of Educational Change.* Toronto: McGraw-Hill.

Goodlad, J. & Klein, M. F. (1970). *Behind the Classroom Door.* Worthington, OH: Charles A Jones Publishing Company.

Knupfer, N. N. (1987). *A Survey of Teacher's Perceptions, Opinions, and Attitudes about Instructional Computing: Implications Regarding Equity.* Doctoral Dissertation: University of Wisconsin.

Sarason, S. B. (1982). *The Culture of the School and the Problem of Change.* Boston, MA: Allyn and Bacon, Incorporated.

Sheingold, K., Kane, J., Endreweit, M., & Billings, K. (1981). *Issues Related to the Implementation of Computer Technology in Schools: A Cross-Sectional Study.* New York: Bank Street College of Education.

Title:

Teachers, Computers, and Power

Author:

Robert Muffoletto

TEACHERS, COMPUTERS AND POWER

by

Dr. Robert Muffoletto
The University of Northern Iowa

As teachers implement computer technology into the schools, they are realizing a change in the power structure inherent in daily classroom life. The very nature of their lessons reflect the shift in power from their own authority to the authority of computer software. Expert systems are being developed which do no less than analyze and direct students paths of learning through the software.

Along with teachers who have developed a sense of confidence in their ability to implement computers are those teachers who feel insecure with technology. At either end of the spectrum, teachers must come to grips with their own role in relation to the computer. If the machine is understood as the expert, what role will the teacher have? This paper will critically address questions about knowledge, where it comes from, how students receive it, and how teachers determine their role in the learning process in relation to the computer.

Title:

Economic, Political, and Social Issues that Affect the Growth of Distance Education

Author:

Marina Stock McIsaac

Economic, Political, and Social Issues That Affect the Growth of Distance Education

Marina Stock McIsaac

Distance education, in which the instructor is removed by time and place from the student, offers the promise of serving the needs of the world's growing population without the massive expense of constructing additional classrooms. Such programs rely on technologies which are either in place or are being considered for their cost-effectiveness. Distance education programs are particularly beneficial for the many people who are not financially or physically able to attend traditional classes.

During the past forty years the world population has doubled to over five billion people, most of whom want to be literate and want greater educational opportunities for themselves and their children. The majority of this expanding population is in Asia which faces massive problems of poverty, illiteracy and disease. In most developing countries, such as Bangladesh, distance education offers the promise of a system of information distribution through which new ideas, attitudes and understanding might begin to "ooze through the layers of the disadvantaged environments" (Shah, 1989, p. 9). Drawing upon the well known model of the British Open University, countries such as Pakistan, India, China, and Turkey have combined modern methods of teaching with emerging technologies in order to provide low-cost instruction for basic literacy and job training (McIsaac, Murphy & Demiray, 1988).

Interest in the field of distance learning is accelerating rapidly with the development of new communication technologies. In addition, many economically developing countries have embarked upon distance education programs by adopting existing models and course development strategies from North America, Australia, Great Britain, and Europe. In the past ten years, record numbers of students in developing countries have gained access to higher education through distance education programs (Rumble & Harry, 1982). However, in many cases, developing nations that are attempting to apply established programs from other countries find it difficult to adapt programs that were designed to meet the needs of a different culture.

Distance educators, particularly those in developing countries, are facing the implementation of massive education programs with little research to guide them. Because of fewer resources in these countries to guide in the development of distance education programs, the lack of appropriate research poses a particular problem.

Telecommunication networks now circle the globe, linking people from many nations together in novel and exciting ways. As the borders of our global community continue to shrink, we search for new ways to improve communication by providing greater access to information on an international scale. Emerging communication technologies, and telecommunications in particular, provide highly cost effective solutions to the problems of sharing information and promoting global understanding between people. In today's electronic age, it is predicted that the amount of information produced will increase exponentially every year. Since economic and political power is

directly related to access to information, many educators like Takeshi Utsumi, President of GLOSAS (Global Systems Analysis and Simulation) have worked to develop models of the "Global University" and the"Global Lecture Hall" which provide resources allowing less affluent countries to keep up with advances in global research and education.

Lack of education breeds inequality among less affluent people and only serves to widen the gap between the "haves" and "have nots". Access to education has long been recognized as the single most important factor for achieving economic and social equality for citizens of developing countries, minority populations in developed countries, and women seeking equal opportunities. Communication technologies offer these traditionally underserved populations the potential for greater equality by providing them with access to global information. There are economic, political and social issues which have direct impact on how the growth of distance education will occur.

ECONOMIC. The most important consideration for the majority of developing countries is economic independence. It is in many of the economically developing countries that the largest distance learning projects are undertaken. A top educational priority for many such countries is to improve the cost effectiveness of education and to provide training and jobs for the general population. The lack of financial resources available for conducting research, particularly prior to embarking on a massive distance education plan, is a common problem. In many cases investing money in research is perceived to be unnecessary and a drain from areas in which the money is needed. Time is an additional problem, since programs are often mandated with very little start-up time. In the interest of expedience, an existing distance learning program from another country may be used and revised but many times this does not adequately answer the needs of the specific population.

One solution to the lack of adequate research available locally has traditionally been the donation of time and expertise by international organizations to help in developing project goals and objectives. The criticism of this approach is that visiting experts seldom have adequate time to become completely familiar with the economic, social and political factors influencing the success of the project. A second, and more appropriate solution, has been to train local experts to research, design and implement sound distance learning programs based on the needs of the particular economy (Tekin & Demiray, 1989: Shah, 1989). Developing nations prefer to train their own experts and direct their own projects. This preference for locally initiated and conducted research can be seen by examining bibliographies and references.

POLITICAL. One goal of education, particularly in developing countries, is to support the political organization of the country and to develop good citizens. Distance education programs which endorse this priority will have greater chance for success. National political philosophies and priorities are found reflected in the diversity of distance education programs around the world. These programs conform to prevailing political and economic values.

In China, for example, the objectives of distance education are to meet the needs of the developing economy and to assist in the national modernization program, part of a massive catch-up effort (Jianshu, 1988). Thailand, noted for its successful distance education program at Sukhothai

Thammathirat Open University (STOU), responds to the national priority of preserving and developing local culture by producing high quality text books in the Thai language. In Turkey, the directive for Turkish higher education expressed in the Higher Education Act of 1981 was a reform measure legislated as a reaction to the political turmoil and civil disturbances which had shaken the Turkish government in the 1970s. This political situation was reflected on university campuses to the point that they were the scene of fighting and even gun battles. The establishment of the distance education program at Anadolu University is an answer to that political directive (McIsaac & Murphy, 1988). Researchers, whether local or foreign , must be sensitive to a country's political environment if their work is to be seriously considered, implemented and widely distributed.

SOCIAL. Researchers and distance learning administrators need to analyze the social conventions of a country and incorporate those conventions into any distance education program before it can be successful. Such social conventions as extended hospitality, differing perceptions of time and the perceived importance of the project can all affect the credibility of the program and, ultimately, its success. In particular, the social classes and roles of women in society must be considered when making recommendations for distance education programs (McIsaac & Koymen, 1988).

The social, political and economic implications of Distance Education are global. Not only do these issues affect education, they affect the entire fabric and variety of diverse cultures through their use of communication technologies. Only if technology is used to enhance prevalent social, educational and political goals will it fulfill its greatest potential. Once again we have the opportunity to use new technologies to solve some of the worlds pressing equity issues. Paradoxically, distance education offers the promise to provide well designed instruction to help remove the distances between people.

REFERENCES

Jianshu, Z. (1988). The development of higher distance education in China. Developing Distance Education. Oslo: International Council for Distance Education, p.450-452.

McIsaac, M.S. & Koymen, U. (1988). Distance education opportunities for women in Turkey. International Council for Distance Education Bulletin. 17, p.22-27.

McIsaac, M.S., Murphy, K.L., & Demiray, U. (1988). Examining Distance Education in Turkey. Distance Education, 9 (1), p. 106.

McIsaac, M.S. & Murphy, K.L. (1988). Turkey: Does distance education meet national educational priorities? Developing Distance Education. Oslo: International Council for Distance Education, p.307-309

Rumble, G, & Harry, K. (eds.) (1982). The distance teaching universities. London: Croom Helm.

Shah, G. (1989). A distance education strategy for Bangladesh. International Council for Distance Education Bulletin, 19, p.9-14.

Tekin, C. & Demiray, U. (1989). A short profile of the first graduates of the open education faculty, Anadolu University, Turkey. International Council for Distance Education Bulletin, 19, p.65-69.

Title:

The 'History' of Technology and Education

Author:

Alfred Bork

THE "HISTORY" OF TECHNOLOGY AND EDUCATION

Alfred Bork

ABSTRACT

There is effectively a standard history of how computers and related interactive technologies are used in educational environments. This history can be the history of an entire country, or it can be the history of a particular group within a country. While there are variants from country to country, and from group to group, it is standard enough that it bears considering. The history, in many ways, is not encouraging. Many of the earlier stages can be considered regretable. Both schools and training show similarities in computer patterns, but schools receive more attention.

The history of technology in education, world wide, is still an incomplete history. In the last section of this paper I discuss a desirable final stage of this history, if we are to move toward a use of technology that improves education. We have serious problems all over the world in our educational systems. Technology offers us the promise, but not the certainty, of being able to cope with those problems. Technology can enhance learning. The last stage in my history reflects what needs to be done to improve educational systems in the world.

INTRODUCTION

Interative information technologies have been widely discussed and used in learning environments of all types. But the results are often disapointing or poor. A technology with great potential is often poorly used.

So far, there seems to be only a little learning from previous mistakes. The tendency is for a new group or a new country to start with patterns previously used that are now recognized by sophisticated users as incorrect. But perhaps early stages and mistakes are necessary for later developments. And some aspects of early stages are useful for later development. By bringing these ideas

and this developmental pattern into the open, it may be possible to avoid constant repetition of mistakes. There is some sign that this can happen.

I do not mean to imply that development involving technology in education is a strictly linear process, although it does seem that some stages precede other stages. As with any complex human activity there is some oversimplification in viewing this complex process linearly. Perhaps a history of this kind might better be written in hypertext! But in much of the description that follows I will talk about the history in a linear fashion, since I am dealing with a linear medium, text. The variation from group to group also confuses the patterns. And statistical data about the progression of steps is not available, and perhaps not really useful.

Many of the features of this history are like those seen with other innovations, but I will not review the more general situation. My attempt is to represent honestly the advantages and disadvantages of interactive technology in all types of learning activities.

The situation is, for convenience, grouped in three stages. First I will discuss beginning stages in the history. Then I will discuss intermediate stages, stages that usually follow the beginning stages. Finally, I will talk about the desirable future of this history.

Again the reader is warned that the outline presented should not be taken in too linear a sense. There are many variations in this history in individual situations. But the patterns are common. The reader might want to compare these stages with a similar history of the use of books in education.

BEGINNING STAGES

The stages discussed in this section represent the most common beginning

activities in the use of computers and related technology in education. These stages can occur together, although the drive toward computer literacy, in its simpler forms, may be later than the others examined. We can see this pattern both at the individual school level, and often at the level of a whole country.

1. "Lets Get Lots of Hardware."

The drive to acquire computers, to move as many computers as possible into schools or universities, is typically the first strong movement we see for technology in education. The acquisition of hardware is the major consideration in this stage. Training activities sometime reflect this early stage also. Teachers given a video projector, but no education in video, would not find the equipment useful.

Teachers and administrators are involved in this strong push toward as much equipment as possible, as quickly as possible. For some, this is perceived as a way to gain visibility. But the main forces involved are probably the commercial world, and the parents. The commercial world is involved for obvious reasons, the desire to market their machines. The parents are driven by another consideration, the vague notion that there is something wrong with a school or university that does not "have" computers. Usually no one involved, the school officials, the teachers, the sellers, or the parents have a clear idea of what the computers are to be used for; only equipment counts. The pattern is different if the school or country cannot afford the hardware; in a sense, the cases of this kind are fortunate, because they can avoid the purchase of large amounts of useless, and soon obsolete, hardware.

Sometimes there is "a" use for the computers, a single use that is promoted heavily. This is a slightly more advanced stage but it is still primarily a hardware oriented stage. The philosophy is "let's get many computers all

running X, and train the teachers so that marvelous things will happen in our school." The life of the typical student is hardly affected by the new hardware, and this software thrust is often short-lived.

Like many stages, this stage does not die, but continues to repeat on and on. We can still see today either the pure hardware acquisitions, or the hardware acquisition driven by one piece of software. This stage is lacking curriculum and learning consideration, an essential component of educational environments that I will frequently return to in this discussion.

We can think of possible historical analogies to this situation. We might speculate that in the early days of printing schools acquired printing presses, with the notion that they would make considerable difference in how things were done. Schools today may acquire video players for all rooms, with little consideration of what educational tapes are available, how they can be obtained, and the role they play in student learning. Unfortunately, educational issues take second place to technological issues in these considerations. That also happens with computers when the emphasis is primarily on acquiring computers; getting hardware.

Within the United States public primary and secondary schools we now have about two million computers. One could question whether it was wise to buy that many computers, given the limited effective use of those computers within classes.

It is not necessary for everyone to proceed this way. In Japan, where both software and hardware technology exist, we see a conscious effort to avoid putting computers into classes, at least as an early stage. In other countries computers have been avoided too, but primarily because they were too expensive, or difficult to produce, for the countries involved. This last group

may be the luckiest!

2. "Lets Teach Languages"

Once the hardware has been acquired in many of these schools there is distinct embarrassment. What is it to be used for? What do students do? The situation is desperate.

One type of software is almost always available, the simple programming languages. They come with the computer in many situations so one common use of these initial machines is to use them for teaching programming. Learning a computer language is usually not what the parents, the teachers, and the administrators have in n ind, but it is possible, and like many things in technology, if something is possible, it often happens without consideration of whether it is desirable. So students learn a computer language, or a fragment of a language.

Given that programming is to be taught, and given that teacher and administrators are good at finding reasons for doing something, we begin to see rationales developed for students learning to program. We hear statements like "almost everyone will need to program in the future." Or statements like "one can only understand computers if one writes programs," or "programming increases problem solving capabilities." These are all dubious, vague assertions with little experimental backing, although the third may eventually prove, with good curriculum units, to be true.

Undoubtedly, programming is useful for some people, and perhaps even for everyone, although that is yet to be demonstrated. Many of the advocates of teaching programming relate it to learning general problem solving strategies. But the research on problem solving have not demonstrated transfer of

problem-solving capabilities. Problem solving in one area is often unrelated to problem solving in another area, it would appear. Nevertheless, there may still be some interesting possibilities in that direction, to be discovered in the future, as suggested.

My view is that far more interesting learning environments, and material, for programming are needed. We can begin to see some possibilities with the development of the Martino the Robot material in Italy, and the Informatics material developed by the USSR Academy of Sciences and Moscow State University. Both of these projects are curriculum-based, not language-based. More work is needed.

The question of whether programming should or should not be taught is at least an open question, and a question that has many associated subquestions: "how" it should be taught, "to whom" it should be taught, "when" it should be taught, and "what" it should replace. When programming is taught in schools there are three major problems. First there is inadequate curriculum material typically for the teaching of programming. Second, the teachers in schools typically know little about modern programming or software engineering. Third, the languages most likely to be used in teaching programming in schools are poor, low-level languages.

I will not comment on the lack of curriculum material for learning to program, except to say that most of the textbooks in this area are written by people with little previous programming experience. The situation with regard to teachers is more obvious. Modern programming is not a simple activity. The software engineering principles involved are not something that can be learned by beginners in a few weeks of a summer program. We would not dream of certifying people to teach mathematics based on a sole mathematical experience of a few weeks in a summer institute, yet we do a similar thing in

programming. A competent teacher of programming needs just as much training as a competent teacher of mathematics. (We are fast approaching the point in the United States where we do not have competent teachers of high school mathematics, too. Recent figures show that only a little more than half of our mathematics teachers are certified to teach mathematics; that is a separate issue.)

The issue of languages requires more attention. There too there is a "history," repeated in many situations. Almost inevitably the initial language is BASIC, although this may be slowly changing. Few computer scientists believe that there is any value in anyone learning BASIC. BASIC was an early language, which did not meet many of the demands of later software engineering. It develops bad habits in the students, almost inevitably in practice, habits extremely difficult to overcome at a later time. The original language has diverged in many directions. There is adequate commentary already, but BASIC continues to be widely taught.

I do not think that the situation is much better with Logo in classes today. Logo does have the possibility of program structure, through its use of procedures, so it is superior in that sense to many variants of BASIC. But Logo is an old language at this point, with a strange syntax, compared to more recent languages. Logo in classes turns out to be about 99 percent turtle graphics, with little to do fundamentally with Logo, since this graphic facility was a later addition after the language was developed. Turtle geometry can be and has been added to almost any language. Most teachers do not understand Logo, and teach accordingly. So results in typical schools are poor.

In the United States, the Advanced Placement exam in computer sciences, leading to college credit, has had a beneficial effect on what language is used, but still the fundamental issues raised above are not touched. The Advanced

Placement exam requires a structured language, Pascal. Since over 95 percent of introductory university computer science courses are based on Pascal, it is not surprising that the Advanced Placement exam in computer science uses Pascal. But the problems mentioned above, with teachers, are still often present. More curriculum material is available.

I remind the reader that I still regard the teaching of computer languages as an open issue. More research is needed, and more experimentation with different ways of learning about programming and problem solving. But even if one ignores all these problems associated with "lets teach languages," this use of computers has little effect within the school environment. Students are studying algebra, physics, English, history, and many other topics. If the computer plays no role in those courses, it is unlikely to have much total effect on the educational system. Hence, the thrust to teach languages, even if it were carried out in an extremely successful fashion, would still represent a limited use of the computer in education, and one using student time that might better be devoted to other purposes. There is general agreement about this in the technical community, but nevertheless languages continue to be taught, often poorly.

3. "Let's Teach Computer Literacy"

This historical development is often a stage beyond the two just discussed. It starts, often, as another name for the teaching of programming languages, one that seems more acceptable to many people. The argument is similar to th at for language teaching: that everyone will need to be computer literate in the society of the future, because computers will be widely used in all activities. Parents, teachers and administrators tend to agree on these issues.

But agreement is lost when one needs to consider what the content of a

computer literacy course should be. Computer literacy is like motherhood in that most people are in favor of it. But unlike motherhood, it does not have a clear and precise definition. People agree that they like computer literacy only because they do not explore carefully what it is that they have in mind by the term, "computer literacy."

Computer literacy is something of a bridging mechanism from the beginning stages of the history of computers in education to the intermediate stages I discuss next. At one stage computer literacy is indistinguishable from the teaching of programming languages perhaps at a simple level. Indeed some textbooks for computer literacy are fundamentally programming texts. All the considerations in the last section apply.

But, as suggested, computer literacy can have a wide variety of meanings. At the lowest level, it can be simply "can I turn the computer on, and insert a disk, and run a program." It may include the use of business-related tools, such as spread sheets and word processors. The meaning of computer literacy continues to evolve, in all countries.

One aspect of computer literacy does seem important, but difficult to get across to students. People need to consider the ethical and moral problems associated with the use of computers. Computers exert a powerful effect on our society. They can exacerbate major social, personal, and economic problems, or they can contribute to the solution of these problems. But the discussion of these issues is handled, if at all, superficially in most computer literacy courses.

Another frequently stated goal of computer literacy courses is to motivate students. Student motivation, in all areas, is important, as it can increase quality time on task, an important factor in how much students learn. My experience in looking at schools that claim to have a computer literacy program

is that a fair amount of this turns into game playing with computers. We get various rationales, primarily the notion that somehow the game is overcoming barriers that the student may have in using computers. I do not see these barriers, particularly with children.

Good user-friendly computer material runs with students with no attempt at trying to convince them that computers are good for them. Or the issues of student excitement are often raised, in using game-like programs. One could equally argue that pinball machines, free candy, or open sex are valuable within classrooms, because they excite the students.

Computer literacy courses have also come to emphasize the learning of common business tools, such as spreadsheets. This is discussed in a later section of this paper.

Toward the end of this historical phase the term computer literacy begins to fall into ill repute. Sometimes it is replaced by other names. In Europe and in many other countries the name Informatics is popular, although it often denotes a higher level course than one associated with the term computer literacy.

4. "Let's Train the Teachers"

It is quickly realized that almost no teachers currently in schools have had any acquaintance with computers. Indeed, the teachers now coming out of schools of education have almost zero acquaintance with computers, because very few schools of education anywhere in the world are in a position to deal with this question adequately. So a movement begins to arise with emphasizes teacher training. As with many of the other stages considered, this is seen as a panecea. We continue to spend large sums of money in this direction, with little in the way of positive results.

This movement is different in different stages of the history. When it comes first in this early stage, it is often concerned with languages and computer literacy. It also follows some of the stages to occur later in this material, such as acquaintance with tools.

The major difficulty with all this is what the teacher should be trained to do. Typically the content of teacher training in technology reflects the stage of the history, as suggested. The fact that there is no coherent use of the computer in education, as will be consistantly pointed out here, raises great difficulties in the issues of preparing teachers to use computers effectively.

To some extent what happens with training teachers about computers now might be thought of in the following fashion. We decide that the overhead projector is to be a major use in education. We run courses on how to use the overhead projector, but we don't supply teachers with much in the way of adequate material, so these courses are content free. We would not expect under these circumstances that courses of this kind would be too valuable.

This suggests that teacher training will not be successful until we have adequate curriculum material using the technology. At that point we will also need something else that is lacking at present, good materials for training the teachers to use these technology-based courses.

NEXT STAGES

At this point the history becomes somewhat more confused, in that not all of these stages are pursued by all groups. Furthermore the order becomes more variable than that just suggested. Often "national policies" of a country, after the initial failures represented in the first stages, begin to come into play, determining these new directions. But the net effects may be similar to

grassroots approaches coming from teachers.

This middle stage in our "history," has a variety of possibilities. There is no clear-cut order in these possibilities and arguments erupt about the "correct" order. Various philosophical positions favor one or the other stage, often almost at the level of fads. So although succeeding sections are numbered, these numbers should not be taken to show strict historical order.

1. "Let's Use Advanced Hardware"

The first stage in this history was the drive to acquire computers. Middle history reflects a similar hardware intensity but the grounds have shifted. Now more powerful equipment is considered.

A variant of this hardware drive occurs in prestigious universities. There it is simply not the equipment that is wanted, but the most advanced (and expensive) equipment that the university feels that they can own. Often large amounts of money go into purchasing this equipment, and developing system software associated with it. I won't mention names, but examples will be well known to many readers. Education takes second place; most of the students are unaffected by this advanced hardware, and most classes continue as they were, without the new computers. It is often argued that these 'experiments' help determine future directions, but the experiments seldom are done carefully enough, and are too individualistic, to provide such data.

Another aspect of this rush to use the latest equipment concerns the use of new technology related to the computer, such as the videodisk, nd the various variants of compact disc. Some groups rush from one equipment to another, looking the the pot at the end of the rainbow.

This is not to say that these devices will eventually not prove to be useful in

learning. I believe they will. But if we always proceed by jumping on the bandwagon of the latest device, the computer will never have any major effect on education! We never seem to use the technology that we have, but rather many individuals are eager to proceed to a newer technology. We *already* have the technology to make major improvements in education in all countries and at all levels. This will be further considered in the final stage of this history.

Again, we see a mistaken emphasis on the hardware, and a lack of attention of what can be done in courses. The computer, with all the new peripherals, still should be considered the major device, because it alone brings interactivity and individualization. But the question of what technology should be used should not be driven by the latest piece of equipment around. Rather, it should be driven by pedagogical considerations. Decisions made without taking into account the full learning context are likely not to be adequate decisions. Thus, if we examine interactive video, the combination of the computer and the video disk, there are some areas where visual information will be extremely important, either for direct content or for motivational reasons, and there are other areas where it may be of little consequence. Deciding in advance that I am going to use equipment X is often a poor decision.

2. i" Let's Develop Small Programs for Use in Standard Courses"

The reaction in this case is to a comment already made in the earlier section. The computer, used in the vein suggested in the early history, has no effect on most of the curriculum, and little effect on most students. Most of the courses taught are in subject matter areas. If the computer is to affect education significantly it must be used in these subject matter areas. Educators slowly begin to realize this.

Hence, we see the beginning of development of computer based learning

material. Normally this early development is at a cottage industry level. A teacher, knowing a little bit about programming, writes a program for his or her students. Large numbers of teachers proceed in this way. The programs are all small, because the teachers have limited time and capability in this area. Then organizations are founded to take the teachers' programs, modify them, improve them, and make them available, perhaps commercially. Thus organizations may begin to develop their own small programs. Many, but not all, of the companies distributing computer based material have histories such as this.

a. Characteristics of Small Programs.

The hallmark of these materials is that they are *small*, not taking students much time. That is, they do not represent any extensive amount of material, but are bits and pieces, minute programs, perhaps occupying an hour or so of student time.

Because of this it is not too surprising that these sequents typically have little effect on the courses in which they are used. A traditional course, based primarily on lectures and textbooks, has a few pieces of computer based material introduced at certain points. Not too surprisingly the overall course is little altered. The student time spent with the computer is likely to be small compared to the time spent listening to lectures, or reading books. So the courses are only slightly altered. Only a small percentage of student time goes to using computer material.

The courses that use such small programs already exist, and are typically based on print material developed many years ago. So their form and content reflects pre-computer strategies. Hence they cannot make full use of the new technologies.

Another problem with many of these small programs is that of quality control. Since they are often developed on an individual scale, without adequate resources, and often by individuals with little experience in developing learning materials, it is not too surprising that the quality is often poor. Yet many of these programs do get used, for the reasons already suggested: the computers are in the schools, and there is some drive to show that the computers are useful in some way to justify the cost of the hardware. Many become commercially available. Some good programs do exist, but too few to improve education for most students, and the programs themselves occupy too little student time to have much effect.

Another interesting, but educationally unfortunate, phenomenon arises in connection with these small programs. Programs that have almost nothing to do with educational content, as it is understood in the traditional fashion, or by those who look toward future systems, become widely used, because they exist, and are perhaps entertaining to children. Thus the enthusiasm for creating computer-based posters, greeting cards, and banners, having little to do with the learning process, reflects the existence of software for doing this. In a sense the software situation is very similar to that with regard to languages, as previously discussed. We have it, so we use it! Since the software exists, it is used, sometimes heavily. Hence the computer has an unfortunate effect on education; it takes away valuable student time from important components of learning, and invests it in material which has little intrinsic learning value.

b. Types of Small Programs.

Several types of these small programs are developed, and again large philosophical discussions break forth about which type is "correct." These philosophical discussions are seldom based on pedagogical or empirical considerations about the needs of students in learning in a course. They are

simply widely held sets of beliefs. Nevertheless they are often argued vigorously. What is lacking is much empirical information to support the arguments, in any direction.

- One common type of material is tutorial, units that try to help the student in the learning process.

- Higher level tutorial material attempts to work somewhat the way an individual tutor might work. At its best, seldom realized, this material can individualize the learning experience for each student, and can make learning an active experience. It also plays a major role in maintaining student interest. Groups of excellent teachers can be effective in designing such units. This is the approach we follow at Irvine.

  But little tutorial material of this kind exists at present, and it suffers from the same problems as any small amount of material. So the potentials for this stage in history are greater, but still remain potential. This topic will receive further discussion in the next major section.

  At the lower end of tutorial is drill and practice, giving students practice in using the material. Drill and practice is often derided, yet in many courses, as they are taught today, drill in learning the materials is almost essential. For example, if one looks at almost any calculus course taught anywhere in the world today, these courses require large amount of practice, drill, in the arts of differentiation and integration. Whether this is a reasonable procedure or not deserves further consideration, but it is unfair to criticize drill and practice on the computer when it is heavily used in noncomputer components of the curriculum. Drill and practice with the computer has distinct advantages over the usual drill and practice, such as the possibility of immediate feedback and assistance to students.

- Another type of small program that has its strong philosophical adherents is the simulation. These go under various names. At Irvine we call them "controllable worlds". If they are done in Logo they tend to be called "microworlds". Sometimes they are called "free environments". The notion of a simulation is straightforward. The computer simulates some part of a real or imaginary world, creating conditions that allow the user to "play" with that world, change it, and observe what happens.

  There is a strong pedagogical purpose for simulation, although not often understood. Simulations are most useful in the important task of helping students to build their intuition about particular areas, to build insight. This experiential phase is an important component of learning, often neglected by our traditional processes. Insight can be stimulated by a rich collection of student experiences provided by simulations.

  But the typical small simulations suffer frequently from a fatal flaw. They are not interactive, so they cannot react to what the student is doing or not doing, and so cannot determine whether the student is building intuition, or gaining any other form of knowledge in the process. Student difficulties are ignored in many simulations.

  So a few students may be learning with the simulation, but many students are not. These later students tend to be bored by the material, since they do not see what is happening, or why they are involved in it. The designers of simulations often assume that student help will come from teachers, but given typical class size this expectation is not at all reasonable in most situations. Student motivation is often a serious problem. Simulations are often far more interesting to the developers than to the students! Students do not understand why they are using the simulation.

  I call a simulation that completely ignores what the user is doing, a naked simulation, because it does not have the "clothes" that it needs to be a

full pedagogical unit. An effective simulation needs to watch carefully what the student knows and does not know, offering help and assistance. But few of these programs do. Naked simulations are seldom useful with typical students, although they may work for very good students with very good teachers. They need to be clothed in pedagogy. A friend tells me that the term 'naked video' has a similar meaning.

- There is a recent alternative to simulations that also is connected with building student intuition, through providing a wide range of experience. This alternative is the micro-computer based laboratory. The notion is to attach a probe directly to the computer, a probe that measures some aspect of the outside world, such as temperature, distance of an object, etc. As with other types of material, little empirical information is available as yet to how this approach compares with the approach of the "pure" simulation. Many scientists favor actual laboratory equipment, even though it is, as in the case of a micro-computer based laboratory, removed from direct manipulation by the student. Typically these programs produce graphs of whatever the probe measures, or whatever can be calculated from this, versus time.

  As with the simulations, most of the microcomputer-based laboratory programs do not pay attention to what the student is doing. So the problems mentioned for simulations also occur. The assumption once more is that the teachers will provide this additional information, without regard for the fact that in the large typical classroom it is usually impossible for the teacher to do this for everyone.

- Some tutorials and simulations get the word "intelligent" attached to them; but these programs seldom actually use the methods of artificial intelligence. We do find a few experimental programs that do use these methods, and we find other programs without artificial intelligence

methods that clothe the simulation. But these are rare at this current stage of the history. The potential, however, is again large.

c. Elitist Programs

A serious problem with many tutorials and simulations is that they only work with a few very good students. The typical student is quickly in trouble. Learning material of this kind deserves to be called *elitist software.*

Given privileged students, or extremely competent teachers, the things that are missing in the naked simulations and simple tutorials can be supplied, at least to a few students. Even here however, the chance of being able to supply the missing details, to everyone in the class, is likely to be small. Too many students are present. Hence, software of this kind often is glowingly reported based on its use with a few bright students and teachers, but fails in typical courses.

3. "Let's Use Authoring Systems"

The drive toward producing small pieces of learning material quickly becomes frustrated, because the teachers involved know little or nothing about programming. Hence, entrepreneurs see a new direction, authoring languages and systems.

Teachers are told that they do not need to know anything about programming. "We have this easy way of allowing you to write learning material, through the magic of computers, where no programming is needed." Anyone can do it, the promoters claim. Languages may start within a professional organization (IBM and Coursewriter, for example).

Authoring languages and systems are heavily promoted and advertised

products. At the 1988 ADCIS meeting in Philadelphia, for example, about half of the exhibitors were promoting authoring systems. Many of these are 15 or so years old. Some reappear under different names. It seems that profits are to be made in this area, given the considerable commercial interests that market authoring systems and languages.

Little quality material is written in these systems. If the systems are easy to use, as advertised, then they produce only simplistic material. As they get more complicated they become less easy to use, but provide a general range of material. When this happens, the systems typically are removed from the hands of the authors, and a new level of professionals uses the system. The original advertising promises are then forgotten.

But these authoring facilities are seldom designed by competent computer scientists who know what a complex programming language or developmental environment should be like, and so they are typically not adequate to the task. Further, they often have a restricted built-in view of the nature of the learning process, or they can produce only certain types of materials. They do, however, absorb great quantities of resources, money and time, and so their net effect on the promotion of computers in education has been negative; they use up money that could be better spent elsewhere. The net result of most authoring systems is to make money for the promoters (sometimes).

But almost every novice getting into the field believes, unfortunately, that the first choice is to pick an authoring system or language! New systems keep appearing, suggesting that some systems make a profit! But little effective material is produced with these systems. It is often not realized that authoring systems, as opposed to sets of tools, are not needed to create high quality interactive learning material. The problem, not discussed further, is primarily a specialized problem in software engineering.

4. "Let's Catalogue Existing Software"

Since many of these small low quality programs are developed, the numbers suggest that we need lists of them. So we find organizations that prepare these lists, and distribute them. Sometimes these organizations are called clearing houses; they also may make available some of the material on these lists. Not too surprising, clearing houses list material of variable quality. If anything has potential, it may be picked up commercially, and so will not be a candidate for the clearing house. So these lists, even relegated to particular fields, seldom turn out to be of much use. A few exceptions exist.

5. "Let's Evaluate the Small Programs"

A step beyond cataloguing is some attempt at evaluating the material. This is certainly desirable, because it begins to give some ideas about which small programs might conceivably be useful in which classes. This might be related, in schools, to the state and local frameworks that guide the curriculum.

But evaluation can have many meanings. What is usually implied at this stage of the history by evaluation is peer evaluation, the program being examined by another teacher who did not write it, but who is familiar with the students in the area. The critical issue, however, is how effective the programs are in helping students to learn. Peer evaluations emphasize teaching, not learning.

Many of the materials glowingly described in peer evaluations turn out to have severe problems when ordinary students are involved in a summative evaluation. Materials liked by teachers, as already suggested, may not work with students; this is not unique to computers. While some useful things can come from peer evaluation these evaluations miss the major direction for evaluation, testing with typical target audiences. Summative evaluation, well done, is expensive

and time consuming in most situations.

The net result of these evaluations, even though the quality of the effort is poor, is to confirm what has already been pointed out, that there is little effective learning material available in the small program category. The nature of the programs, that they are small, almost assures that this will be the case. The material is not extensive enough to make a real difference.

6. "Let's Teach Students About Tools"

An entirely different approach is seen, often toward the end of this middle stage of our history. The argument resembles what we have already seen in computer literacy, at least in its earlier stages. It goes something like this. Powerful computer tools are now generally available in our society. Students may almost certainly use these tools after they graduate from school or university. Hence, let's be sure to teach them all about the tools that are currently available. As with learning languages, this philosophy can be questioned.

The first thing to note is that the tools usually being referred to, word processors, spreadsheets, data base manipulators, graphics programs, have almost all come from the business community. That is, *none of them* were developed for use in the learning process. I sometimes refer to this stage in the history as "picking up the crumbs of the business table."

a. Business Tools in Classes

Because these tools were developed for business considerations to meet business needs, it would seem almost obvious that they are not ideal for educational purposes. But this seems to have escaped most of the people who pursue this direction. Often the tools used are not exactly those that were developed for business. The reason for this is that the computers they are

running on are computers that businesses refuse to buy! Thus weaker forms of the business programs, imitations for the weaker computers, are often developed for the school or university environment. Schools often do not use the "best" business tools, even when they have the appropriate computers.

Where should the tools be taught? Often the computer literacy course is revived in this context, and it becomes a course for learning about word processors and other tools. But we also see use of tools within subject-matter classes, and some of these approaches are useful, at least slightly. Thus a spreadsheet may get used within a mathematics class, or within a class in the sciences. The published literature contains many examples of this kind, and we find enthusiasts for this use.

Perhaps the most important use of such tools within a class is the use of word processing within the learning of writing. Word processors will soon be almost universally used in almost any type of writing activity, so the presence of word processors in courses in learning to write, or that involve substantial writing, is not surprising.

Within these courses it may be the student's responsibility to learn how to use the word processor sufficient to the needs of the course. This is often the case, for example, in junior and senior level English courses in universities, where it becomes almost impossible to survive in the course, given the amount of writing needed, without a word processor. Learning to use the tools is not simple, and often little help is provided.

Certainly the word processor is very useful in writing, and in learning to write. The ability to make corrections easily, without the laborious processes involved in rewriting and retyping entire papers, shows the potential for improving writing. Spelling checkers also play an important role.

The word processor is only one of many computer-based tools that can be useful in the writing environment. Furthermore the learning of writing involves a whole methodology of which word processing is only a small segment. Learning to write has undergone a revolution recently, with emphsis on viewing the entire process of writing, not just the actual writing activity. The notion that there are tools that can assist with the prewriting process, and tools that can help with the post-writing or revision process, are central to using computers effectively in a process approach to improving writing. Yet these tools are often fragmentary, and seldom put together in a full scale curriculum designed for learning writing and for later productive writing. Although there are some exceptions to this, these exceptions are not the most commonly used tools in writing.

b. New Tools

The use of tools does not end with the business tools. New tools are particularly developed for areas of the curriculum.

To some extent these tools overlap types of software considered previously, particularly simulations. As with the business tools, problems arise from the issues of curriculum.

c. Curriculum Context of Tools

The emphasis on a curriculum context, just expressed in the use of word processing within the teaching of writing, is an important and neglected consideration for most of these tools. Having the tools alone, whether they are word processors, spreadsheets or other things, is seldom sufficient.

What is needed is a whole collection of software to use with the tools. This software needs to address the following questions.

- How is the student to learn to use the tools? How many hours of valuable class time in a writing course are going to be devoted to teaching people the mechanism of various tools? Or is there some more effective way of doing this?
- How do the tools integrate with each other, and how do the students understand that the important thing is not the tools themselves, but the curriculum material that one is trying to get across?
- How do the tools fit with other aspects of the curriculum.
- Does the tool make any attempt to determine if the student is learning anything?
- Does the tool offer any individualized assistance to the student who is in difficulty? Or does it assume that the already overworked teacher will work individually with each student in a large class?

All these questions are seldom answered, because the tools are plucked from business applications, with little pedagogical context surrounding them. The problem is not too unsimilar to the problem of the naked simulation, mentioned above. The focus is not on learning, and on helping students to learn, but on the technology. A friend likes to say that any piece of learning without a curriculum context is like a "one night stand." The analogy seems to me a good one; no full rich relationship is developed.

But even if we can answer all these questions carefully, and develop a full curriculum context for the use of tools, the question remains as to computer use in many other areas of the curriculum where the tools may not be as vital, but where other kinds of technology-based learning material may play a more important role. The notion that somehow education needs to use only the tools

that have been developed for business is a very peculiar notion, reflecting the poverty of education today.

7. "Let's Use Networks"

One stage that is eventually reached in many countries and in many individual projects is the stage that focuses on the use of networks, at first local networks, and then long distance networks. That is, the standard personal computer is no longer seen as adequate, but the student also needs connections between computers, and the resources that networks can provide. It is not necessary that every user be networked all the time; many long distance networks assume that only occasionally will there be a connection made by phone, sometimes without knowledge of the student.

Initially the use of networks becomes almost purely a matter of convenience and bookkeeping. The convenience comes because it is no longer necessary to deal with all the floppy disks. The bookkeeping comes because now it is possible to keep better records about what the student has or has not done. The next stage is the use of electronic mail and bulletin boards, often poorly coupled with the curriculum; these activities can be valuable if integrated with the curriculum.

But seldom has any learning material been developed that *demands* the network, other than the use of electronic mail and bulletin boards. A few exceptions exist, such as the National Geographic/TERC science units. Although there would seem to be some interesting possibilities for pedagogical developments that could take place in network environments, and could not take place in other environments, these possibilities have scarcely been touched. So networks become an expensive addition, not contributing much to the learning situation. But like many of the early stages in the history, they reflect a potential that might be realized if the final stage of history is ever attained.

8. "Let's Develop Management Systems"

Sometime, usually early in the second stage, the notion of using the technology to provide course management, with or without any of the rest of the material in the course involving the computer, is broached.

The argument for management systems is reasonable. Teachers spend much time with paperwork, time they do not consider interesting. If the management system can indeed cut down this time, then it has considerable appeal for the teachers.

At the simplest level the management systems become simply the replacement for the teacher's record book, a way of recording the grades and progress of the course by the teacher directly. Thus the teacher gives tests, and instead of entering grades in a written form in a record book, they are entered online, hopefully with a friendly query-type program. Perhaps the computer does some mathematics, such as averaging the grades. Such use is of minimal interest.

More advanced forms of management systems may tie in directly with other material on the computer, so that the information is recorded automatically. Systems of this kind do exist. Probably we can expect more of them in the final stage of the history. The integrated system available from such companies such as Computer Curriculum Corporation and WICAT combine management systems with extensive curriculum material.

The purpose of management systems is not given much consideration. Often it is only the teacher that is thought of in recording the information, and supplying various reports. But equally, and perhaps of greater importance eventually, is a management system that supplies help directly to the student. Such a system is necessary if the student is to understand what he or she needs

to work on further. Management systems can thus offer a variety of interfaces, for different users.

FINAL STAGE OF THE HISTORY

Up to this point there has been I believe historical accuracy in telling what has happened. However, like any archetypical history that tries to encompass an entire movement, the individual details may be different than those described. The account we have so far brings us roughly up to the present. The computer, the videodisk, and the compact disc are still having little impact on improving education. Some of the reasons for this have been discussed in the early sections of this paper.

But this history is incomplete; we have not reached the desirable final stage for effective use of computers within the classroom environment. The next stage of the history has not yet taken place, in any country or in any organization, although some are closer to it than others. In this section, I give a quick view of what I regard as the next stage of the history. Many of my papers and books expand this in more detail. The reader is referred to those for expanded details.

This last stage in history might be described as "let's develop full curriculum using computers." It uses all the previous experience, including some historical forerunners to the last stage that I have not mentioned.

a. Visions of Future Educational Systems

I find surprisingly little discussion of the desirable forms of future learning systems, of any type. This discussion is much needed; it is difficult to know how to improve schools if we do not have a target for the future. Most of the use of technology in education has ignored this issue.

b. New Courses and Curricula

The only way interactive information technologies can be used effectively in education, just as the only way the book could be used effectively, is to develop entirely new courses. These new courses need to assume from the beginning of the development process that *all* educational media, including those from modern interactive technology, are available. Such material would lead to new curricula. It would go far beyond the bits and pieces of technology-based material now available.

These courses could well differ greatly in form, content, and teacher role from existing courses, because they have been developed later. Content needs change because of our changing society. New forms for course structure are suggested by new learning technologies. Exciting possibilites exist that would have been impossible with the older learning media.

But little in the way of resources have been devoted to full curriculum development based on interactive technology. Indeed most of the money associated with computers in education, in the United States, is still invested in the earlier stages already mentioned in the first two parts of this paper, even today. Some full courses have been developed: the logic and set theory courses at Stanford University, the physics course at the University of California, Irvine, and the Writing to Read course for young children. But these courses are a drop in a very large bucket, if we consider all the systems of education in existence.

This lack of full-scale interactive courses is curious. Hundreds of full video-based courses have been developed, some slightly interactive, but only a very small number of computer-based courses. We cannot realize the full potential of interactive learning technology without newly designed courses. I find it hard to understand why video has had so much more support, given that

most video-based courses are not interactive.

c. Teacher Training

The fact that we are considering courses that are quite different than previous courses, including different teacher roles, indicates the great importance of educating the teacher. Current efforts at educating the teacher in something called "technology" are typically unsuccessful, because the technology is not tied down to pedagogical situations. We do not train teachers to use books!

The training of teachers must be associated with each of the new courses developed, and the development of this material for teachers must be considered an integral part of the development of the courses. One of my friends, Jaques Hebenstreit, has emphasized this recently in private correspondence. He comments, "The constructive use of computers is not a problem in hardware and not even a problem in software. It is a problem of making teachers confident."

d. Evaluation

So the focus of the final stage will be on full course development, so that we can rebuild schools and universities with technology-based courses that were not possible with the older technologies. One can see glimmerings beginning in a few countries, but still it is a stage that we are perhaps not ready for at present.

These full courses also need to be accompanied by full summative evaluations. The importance of testing learning material with students has already been stressed in discussing evaluation in the previous stage. It is desirable that several such courses will be available in each area, so that these courses can be compared for student effectiveness not only with the conventional courses, but with each other. Writing to Read has been evaluated in this sense, but such

evaluations are seldom done.

e. Implementation

The use of these new courses in all areas of learning is a complex task. Educational institutions of all types are conservative, and do not change easily. But we know, from industry experiences, something about implementation of major changes in education. That experience will be useful here.

f. Conclusions

The potential for this last stage in our history is exciting. We have great problems in education, and it is only with this redevelopment of our courses and schools that we can begin to face these issues and proceed through to this final stage.

Title:

Educational Technology Curriculum Theory: Toward a New Language of Possibility

Author:

J. Randall Koetting

EDUCATIONAL TECHNOLOGY CURRICULUM THEORY AND SOCIAL FOUNDATIONS: TOWARD A NEW LANGUAGE OF POSSIBILITY

by

Dr. J. Randall Koetting
Oklahoma State University (Temporarily at Reno, Nevada)

There is an increasing body of critical literature in the social foundations and curriculum theory that could identify a new language of possibility within the applied field of study of educational technology. This literature could move toward the reconceptualization of taken-for-granted assumptions and provide new directions for research and study in our field. It also has the possibility of broadening the dialogue of those in our field with diverse educators within other areas of study. This paper will explore current literature in these areas of study (social foundations, curriculum theory, and critical pedagogy) and will suggest the importance of reconceptualizing educational technology within a framework of a new language of possibility. The piece will be presented from a conceptual, theoretical perspective.